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PSYCHOACTIVE PLANTS IN NEED OF CHEMICAL STUDY

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Reports on the inebriating properties of plants — some employed in magico-religious ceremonies of primitive societies in various parts of the world — continue to appear Their sources are many: reports of travellers, anthropological writings, historical documents, herbarium specimens and others. The diversity and wide occurrence of the reports has tended to keep them from the scrutiny of investigators who might have studied the plants for the ascertainment of their active principles.

In an effort to focus attention on some of these presumably psychoactive plants, the following notes are offered. Only those species which seem most urgently in need of attention are listed. There are others which appear to be promising, but which may be of less urgent interest because of the vagueness of the ethnobotanical reports of their use or because of extreme difficulty in procuring sufficient supplies of the plant for phytochemical study. Even though the number of species listed below is limited, it is obvious how much remains to be done in the interdisciplinary study of biodynamic plants.

A very recent survey of natural hallucinogens has pointed out that more than 200 species of higher plants comprised the study, that they are widely distributed in the Plant Kingdom (146 genera in more than 50 families) and that the active principles are known for only about 45 species (Schultes and Farnsworth 1980). This survey attributes the lack of chemical knowledge of these plants to two causes: 1) the lack of good animal models which the chemist can utilize in monitoring his isolation work; and 2) the paucity of field work of scientific trustworthiness in fast disappearing aboriginal societies. The survey ends with the statement that the "...Plant Kingdom remains a fertile and almost virgin territory for those interested in the discovery of new psychoactive drugs, not to mention other types of biologically active compounds waiting in silent hiding."

The extreme paucity of phytochemical studies on these plants of very significant use in primitive societies emphasizes one of the most important results from ethnobotanical investigations: the ability to orient chemical analyses along lines of biodynamically useful species.

One of the enigmas in modern ethnobotany is the cause of the disparity in use of psychoactive drugs between the New World and the Old World. The disparity in known psychoactive plants used in local cultures is indeed great. The Old World cultures are older than those of the New World. Since there is no botanical reason to suspect that a great disparity exists between the two hemispheres in the number of plants containing psychoactive constituents, the reasons must lie in cultural causes. The present interest in China and India in sophisticated examination of their ethnopharmacological heritage, however, should result in a definite increase in the number of plants employed for psychoactivity.

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LYCOPERDACEAE

Lycoperdon marginatum Vittadini, Monogr. Lycoperd. (1843) pl. 1, Fig. 11.

L. mixtecorum Heim in Comptes Rend. 254 (1962) 789; in Rev. Mycol. 31 (1966) 156.

Tarahumare medicine men in northern Mexico take puffballs which they call *kalamoto* to make it possible to approach people without being seen and in order to cause sickness [Bye: in Diaz: Cuad. Cient. Cemef. (Mexico), no. 4 (1976) 49-72]. The Mixtecs of Oaxaca in southern Mexico take two species of *Lycoperdon* — *L. marginatum* and *L. mixtecorum* — to induce a condition of half-sleep during which they experience auditory hallucinations [Ravicz: An. Inst. Nac. Antrop. Hist. 13 (1960) (1961) 73-92]; Heim: *Nouvelles Investigations sur les Champignons Hallucinogénes*, Edit. Mus. Nat. Paris (1967) (195-199).

No psychoactive principles are known from the genus *Lycoperdon*.

GRAMINEAE

Cymbopogon densiflorus Stapf in Prain, Fl. Trop. Afr. 9(1918) 289.

The flowers, smoked either alone or with tobacco by witch doctors in Tanganyika, "causes dreams" which are believed to foretell the future. Native medicine men in Tanganyika are said to emply this grass as an intoxicant (Herbarium collection: *Newbould et Hartley 4319*).

Active principles are as yet unknown from Cymbopogon.

CYPERACEAE

Scirpus sp.

In northern Mexico, the Tarahumare fear *bakana*, a species of *Scirpus*. It is believed to cure insanity, and the whole plant is thought to protect the mentally ill. These Indians hold that the intoxication induced by this sedge permits them to travel over great distances to speak with their ancestors. Brilliantly coloured visual hallucinations are induced [Bye in Diaz: Cuad. Cient. Cemef 4 (1975) 61-62].

Harmala alkaloids have been reported from *Scirpus* and the related genus *Cyperus* [Raffauf: *A Handbook of Alkaloids and Alkaloid-bearing Plants*, Wiley-Interscience, New York (1970)]; Willaman and Schubert: *Alkaloid-bearing Plants and their Contained Alkaloids*, U.S. Govt. Printing Office, Washington, D.C. (1961) 80.

ARACEAE

Acorus calamus Linnaeus, Sp. Pl. (1753) 324.

The Cree Indians of northwestern Canada are believed to chew the root of this plant for its hallucinogenic effects. It can induce hallucinogenic conditions in excessive doses.

While it has been suggested that α-asarone and β-asarone, which have structural resemblances with mescaline, may be responsible for the psychoactivity, there is as yet no evidence that asarone can be associated with hallucinogenic activity [Hoffer and Osmund: *The Hallucinogens*, Academic Press, New York (1967) 55-56].

MORACEAE

Helicostylis tomentosa (P. et E.) Rusby in Mem. Torr. Bot. Club 6(1896) 120.

H. pedunculata Benoist in Bull. Mus. Hist. Nat. Paris 25 (1919) 298.

Takini is a Karib Indian name for several species of *Helicostylis* in the Guianas. It is reported that the Indians and bush Negroes of Surinam employ the reddish sap or latex of the bark, which is mildly toxic, as an hallucinogen in ceremonial witch-craft. The identity of the source tree has not yet been definitively settled, but it is presumed that these two species of Helicostylis may be utilized (Stahel: *De Nuttige Planten van Suriname*. Bull. no. 59, Dept. Landbouw-proef-station, Suriname, 1944; Ostendorf: *Nuttige Planten en Sierplanten in Suriname*.

Bull. no. 79, Landbouwproefstation Suriname, 1962; Kloos: *The Maroni River Caribs of Surinam.* Van Gorcum and Comp., n.v., Assen, Holland, 1971; Lindeman and Mennega: *Bomenbock voor Suriname,* Dienst's Lands Bosbeheer Suriname, Paramaibo, Surinam, 1963). The source tree has also been variously attributed to the genera Piratinera or Brosimum of the Moraceae (Hegnauer: *Chemotaxonomie der Pflanzen,* Birkhäuser Verlag, Basle, 5 (1969) 109 or even to the euphorbiaceous Pausandra (de Goeje: *Philosophy, Initiation and Myths of the Indians of Guiana and Adjacent Countries,* Leiden, 1943).

Extracts of the bark of both of these species of *Helicostylis* have elicited central nervous system depressant effects in animals similar to those expected from Cannabis, but the actual active chemical constituents remain to be characterized (Schultes and Farnsworth: loc. cit., 183-184).

ZINGIBERACEAE

Kaempferia galanga Linnaeus Sp. Pl. (1753) 3.

There are vague reports of the hallucinogenic use of *maraba* (*Kaempferia galanga*) in New Guinea [Barrau: Journ. Agric. Trop. Bot. Appl. 9 (1962) 245-249].

The rhizome of this plant is rich in essential oils, but psychoactive principles have not yet been reported [Hegnauer: loc. cit. 2 (1963) 461].

ORCHIDACEAE

Oncidium cebolleta (Jacq.) Swartz in Vet. Akad. Handl. Stockh. 21 (1800) 240.

This epiphytic orchid is said to be valued by the Tarahumare Indians of Mexico as an hallucinogen, employed when there is no supply available of the peyote cactus [*Lophophora Williamsii* (Lem.) Coult.] (Bye: loc. cit.).

An alkaloid of unknown structure has been reported from *Oncidium cebolleta* [Willaman and Li: *Alkaloid-bearing Plants and their Contained Alkaloids,* Lloydia, Suppl. 33, no. 3a (1970) 151].

MORACEAE

Maquira sclerophylla (Ducke) C. C. Berg in Acta Bot. Néerl. 18 (1969) 463.

An hallucinogenic snuff is said formerly to have been prepared from the fruits of the gigantic forest tree *Maquira sclerophylla.* It was employed ritualistically in dances in the Pariana region of the Brazilian Amazon, where the snuff was known as *rapé dos indios* [Schultes: Harvard Rev. 1, no. 4 (1963) 26; Psych. Rev. 1, no. 2 (1963) 158].

This gigantic tree of the Amazon forest was formerly known as *Olmedioperebea sclerophylla* Ducke.

No chemical studies of the fruits of this tree have apparently been carried out, nor is there absolute certainty that the snuff was made from this fruit alone or with other

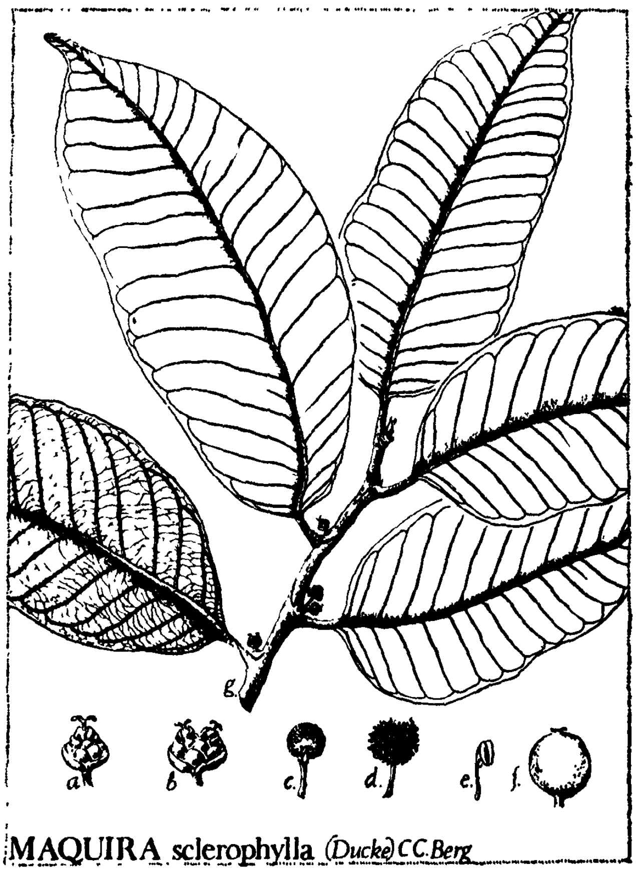

Fig. 1: *Maquira sclerophylla* (Ducke) C. C. Berg

plant ingredients. Much more ethnobotanical research is needed, especially since apparently only the very aged now know how to prepare the drug.

HIMANTANDRACEAE

Homalomena sp.

The natives of Papua are said to eat the leaves of a species of Homalomena, called *ereriba,* with the leaves and bark of *Galbulimima Belgraveana* (F. Muell.) Sprague to induce a narcosis characterized by a violent and crazed condition followed by deep sleep; they see and dream about men and animals which they are to kill. [Barrau: Journ. Agric. Trop. Bot. Appl. 5 (1958) 377-378].

No toxic substance is known from Homalomena, although twenty-eight alkaloids have been isolated from the bark of *Galbulimima Belgraveana;* there is no indication, however, that these alkaloids are hallucinogenic [Ritchie and Taylor: In Manske, R. H. F. and H. L. Holmes (Eds.) *The Alkaloids,* Academic Press, New York 9 (1967) 529-543].

GOMORTEGACEAE

Gomortega keule (Mol.) I. M. Johnston in Contrib. Gray Herb., n.s., 3, no. 70 (1924) 92.

In Chile, the Mapuche Indians once used the fruit of this evergreen tree as a narcotic. The tree is apparently endemic to central Chile [Mariani, R.: *Témas de Hipnosis,* Ed. Andres Bello, Santiago, Chile (1965) 357-358].

The fruit is apparently very rich in essential oils, but no psychoactive chemical constituent has as yet been isolated; the chemistry of the plant is not known [Hegnauer: loc. cit. 4 (1966) 210].

LEGUMINOSAE

Caesalpinia sepiaria Roxburgh, Hort. Beng. (1814) 32.

In China, this plant—known as *yün-shih*—is reported as an hallucinogen. An early Chinese herbal, the *Pen-ts'-ao-ching,* states that the "flowers could enable one to see spirits and, when taken to excess, cause one to stagger madly." And they may even cause, when ingested over a period, levitation and "communication with the spirits" [Li: Bot. Mus. Leafl., Harvard Univ. 25 (1977) 161-181].

An alkaloid has been isolated from *Caesalpinia sepiaria* but its structure and physiological activity are still unknown (Raffauf: loc. cit.).

Canavalia maritima (Aubl.) Petit-Thouars in Desvaux, Journ. Bot. 1 (1813) 80.

On the Gulf Coast of Mexico, this plant is reputedly often substituted for *marijuana,* but there is no record of its use in modern societies. While seeds have been found in graves in southern Mexico, there is no report of its use in our cultures. In Peru, remains of this plant have been found in sites dated from 300 to 900 A.D. (Diaz: loc. cit. 181).

L-betonicine has been found in *Canavalia maritima,* but this compound is apparently not hallucinogenic (Diaz: Loc. cit. 181; Raffauf; loc. cit.).

Piscidia carthaginensis Jacquin, Enum. Pl. Carib. (1762) 27.

This plant is known in Martinique as *bois enivrant* ("intoxicating wood"). The use of the leaves, crushed and thrown into the water, as a fish poison is well recognized. Less well known, however, are its narcotic properties. The fruit, according to the collector, has a "tonic and narcotic principle" (Herbarium collection: *P. Duss 120b*).

Active principles have not yet been reported from the genus *Piscidia.*

Zornia latifolia De Candolle, Prodr. 2 (1825) 317.

The leaves of *Zornia latifolia,* known in Brazil as *maconha brava* ("wild marijuana") are dried and smoked as an "hallucinogenic substitute for Cannabis" (Herbarium collection: *Prance, Rodrigues et al. 8917*).

No psychoactive constituent is known from *Zornia*.

ERYTHROXYLACEAE

Erythroxylon cataractarum Spr. ex Peyritsch in Martius, Fl. Bras. 12 pt. (1878) 149.

COLOMBIA: Comisaría del Vaupés, Río Kubiyú, along bank. "Small tree 4 m tall, leaning over water in inundated area. Leaves yellowish green. Grows only along river. Fruit readily eaten by fish." July 3, 1975. *Zarucchi 1383* — Same locality, July 10, 1975. *Zarucchi 1423* — Río Piraparaná, near Misión de San Miguel. "Tree to 8 m ; trunk to 26 cm wide. Flowers cream. Fruits green, ripening red." October 25, 1976. *Davis 151.*

According to Zarucchi, this tree, known locally as *coca de pescado* (undoubtedly because the fruit is eaten by fish), is "almost as strong as 'cocaina'" and is "used by people who do not have a coca patch." It is said to be "a very strong, wild coca, one of the wild cocas used prior to the introduction of cultivated varieties; presently the cultivated is preferred because it is not so strong." Davis reports that the Barasana Indians maintain that this coca can be eaten and that "it was the coca of our fathers."

Chemical examinations of this wild species of Erythroxylon apparently have not yet been effected.

CORIARIACEAE

Coriaria thymifolia Humboldt, Bonpland ex Willdenow, Sp. Pl. 4, pt. 2 (1806) 819.

This high Andean shrub, known in Colombia and Peru as *shanshi*, has long been feared as a virulent poison for browsing animals. The fruits are said to be ingested by Indians in parts of Ecuador to induce an intoxication characterized by sensations of flight [Naranjo: Terapia 24 (1969) 5-63].

The hallucinogenic effects may be due to a glycoside of unknown structure [Naranjo and Naranjo : Arch. Criminol. Neuro-Psiquiatr. Discipl. Conexas 14 (1964) 4], but much more chemical study is needed before the psychoactivity of this plant is understood.

SAPINDACEAE

Ungnadia speciosa Endlicher, Atakt. Bot. (1833) t. 36.

The seeds of the *Mexican buckeye*, considered toxic, may once have been employed as an hallucinogen. They have been found in archaeological sites in northern Mexico and Texas dating from 7500 B.C. to about 1000 A.D. These caches have been associated with remains of the mescal bean [*Sophora secundiflora* (Ort.) Lag.] and peyote [*Lophophora Williamsii* (Lem.) Coult.], both hallucinogens, and the seeds of the Ungnadia would appear to have been used in a religious context [Adovasio and Fry: Econ. Bot. 30 (1976) 94-96].

The seeds of the Mexican buckeye contain cyanogenic constituents [Hegnauer: loc. cit. 6 (1973) 279].

MALVACEAE

Sida acuta Burmann fil., Fl. Ind. (1768) 147.

S. rhombifolia Linnaeus, Sp. Pl. (1753) 684.

Mexican natives attribute psychotropic properties to these plants (Diaz : loc. cit. 183-186 ; Lozoya : (Ed.) *Estado Actual del Conocimiento en Plantas Medicinales Mexicanas*, Instituto Mexicano para el Estudio de las Plantas Medicinales, Mexico 10 (1976) 109-130. Phytochemical study of this genus is merely in a preliminary stage.

CACTACEAE

Pachycereus pecten-aboriginum (Engelm.) Britton et Rose in Contrib. U.S. Nat. Hist. 12 (1909) 422.

The Tarahumare Indians of Mexico are said to use this large columnar cactus as a narcotic which they call *cawé*. What its exact effects are remains doubtful [Pennington: *The Tarahumar of Mexico — their Environment and Material Culture,* University of Utah, Salt Lake City, Utah (1963) 166, 167; Bye: loc. cit. 59-60].

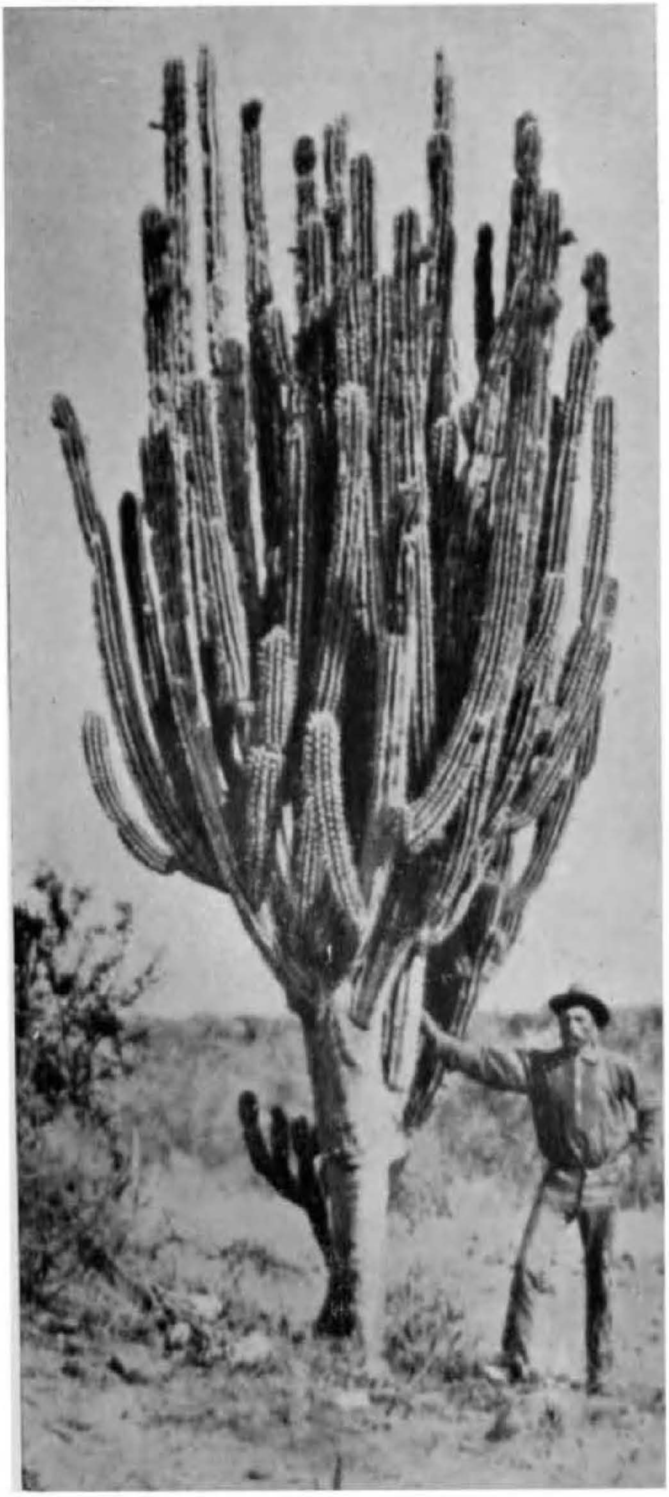

Fig. 2: *Pachycereus pecten-aboriginum.* From Britton & Rose *The Cactaceae* 2(1920) fig. 175.

This plant contains the alkaloid carnegine or deshydroxy-pellotine [Agurell: Lloydia 32 (1969) 206-210; Bruhn and Lindgren: Lloydia 39 (1976) 175-177; Späth: Ber. Dtsch. Chem. Gesel. 62 (1929) 1021-1024].

DESFONTAINIACEAE

Desfontainia spinosa Ruiz et Pavón, Fl. Peru 2 (1799) 47, t. 186.

Known in Chile as *taique*, in Colombia as *borrachero* or *borrachero de páramo*, this high Andean shrub has been reported as an hallucinogen in use by Indians of Chile and of Colombia [Schultes: Bot. Mus. Leafl., Harvard Univ. 25(1977) 99-104].

Although the family Desfontainiaceae seems to be closely related to the alkaloid-rich Loganiaceae, nothing is as yet known of the chemical constitution of *Desfontainia spinosa*.

LABIATAE

Coleus blumei Bentham, Lab. Gen. et Sp. (1832) 56.

C. pumilus Blanco, Fl. Philip., Ed. 1 (1837) 482.

Two species of *Coleus* — *C. blumei* and *C. pumilus* — are possibly employed in Oaxaca, Mexico, as hallucinogens. Both species are introductions from Asia [Wasson: Bot. Mus. Leafl., Harvard Univ. 20 (1962) 79].

As yet, no psychoactive constituent has been found in the genus.

SOLANACEAE

Iochroma fuchsioides Miers in Hooker, Lond. Journ. Bot. 7 (1848) 345.

This beautiful shrub is known in southern Colombia and Ecuador as *arbol de campanilla, borrachera, borrachera andake, nacedero, flor de quinde* ("hummingbird flower"), *panguana* or *guatillo* in Spanish, *totubjansushe* or *tutujansushe* in the Kamsá Indian language. In the Valley of Sibundoy the bark is made into a tea which is in mild doses employed as a purgative, especially when there is internal bleeding; in cases of internal injury from severe blows, the root is rasped and eaten raw with salt; the root with other unidentified ingredients may be used as a contraceptive (Bristol: *Sibundoy Ethnobotany*, Ph. D. thesis, unpubl., Harvard University, 1965).

The plant is valued in preparing a narcotic with hallucinogenic effects. The leaves are simply crushed in water with a handful of freshly rasped bark from the stem; this mixture is then gently heated. The hallucinogenic dose is from one to three cupfuls of this strong decoction over a three-hour period [Schultes: Bull. Morris Arb. 21 (1970) 14; Journ. Psyched. Drugs 9 (1977) 45-49].

The hallucinogenic constituent may be alkaloidal. Raffauf has had positive tests for alkaloids but merely in preliminary field tests (Bristol: loc. cit.; Schultes: loc. cit.).

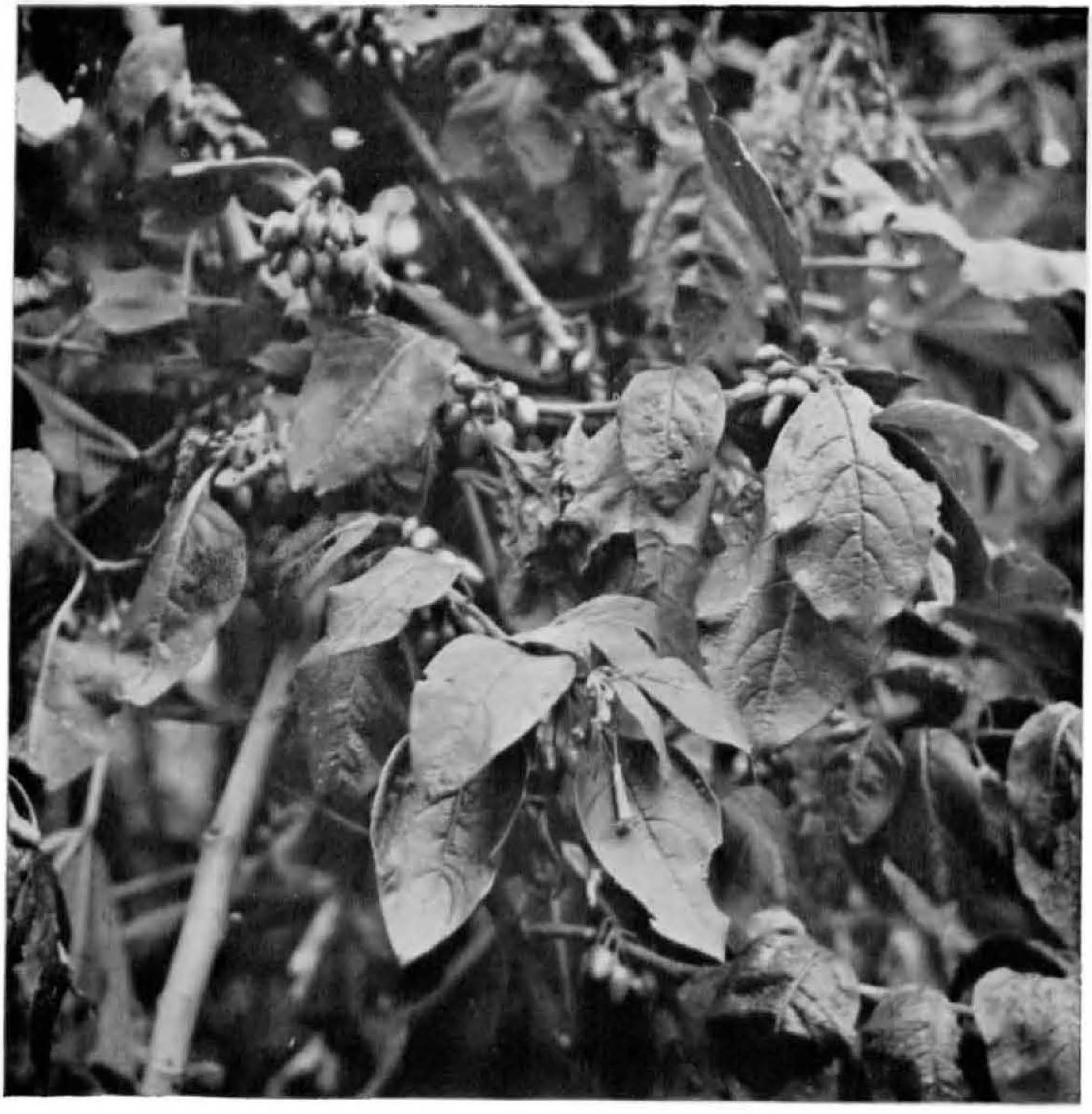

Fig. 3: *Iochroma fuchsioides*. Pasto, Colombia.

The following chemical examination of *Iochroma fuchsioides* on a renin-inhibitor is apparently all that is known of this genus. "Extracts of *Iochroma fuchsioides* were found to inhibit the enzymatic activity of renin in a fluorometric assay system utilizing a synthetic octapeptide substrate. Subsequent testing in other renin assay systems using the natural protein substrates confirmed this inhibitory activity, although the I_{50} values were much much less in the plasma systems with natural substrate. The crude aqueous extract gave an I_{50} of 5.6 g/ml in the fluorometric assay system, but it was 150 g/ml in the rabbit plasma system. *In vivo* activity was also demonstrated in experiments with rats infused with renin. Intravenous injections of both crude and partially purified preparations lowered the elevated blood pressure of such rats.

"Partial purification of the inhibitor present in aqueous extracts of the plant was accomplished by ammonium sulfate precipitation followed by molecular sieve chromatography on Sephadex G-50. Two active fractions were obtained. The larger molecular weight fraction was not retarded on the Sephadex G-50 column, and assayed only about 40% as active as the crude extract. The smaller molecular weight fraction, which was eluted after about two column volumes, was found to be eight times as active as the starting crude extract.

"The active component in the smaller molecular weight fraction appears to be a heat stable glycopeptide in the 4,000-6,000 molecular weight range, and is anionic at neutral pH. Thus far, attempts at further purification have not been successful." (Miller, Svoboda and Tafur: pers. comm.).

BIGNONIACEAE

Tanaecium nocturnum (Barb.-Rodr.) Bureau et K. Schumann in Martius, Fl. Bras. 8, pt. 2 (1896) 186.

The Paumaré Indians of the Rio Purús in the Brazilian Amazon prepare a snuff for use by medicine men. The green leaves are shredded, roasted, pulverized and sifted through a fine cloth, and the resulting powder is mixed with tobacco snuff (*Nicotiana tabacum* L.). This mixture is presumably psychoactive [Prance: Econ. Bot. 24 (1970) 62-68].

A preliminary chemical examination indicated a high concentration of hydrogen cyanide in the fresh leaves (Schultes and Hofmann: loc. cit., 360-362).

RUBIACEAE

Pagamea macrophylla Spruce ex Bentham in Journ. Linn. Soc. 1 (1857) 110.

The leaves of this shrub are dried and powdered to prepare a snuff used during curing in divinatory séances by medicine-men in the Río Piraparaná of Amazonian Colombia. [Schultes: Bot. Mus. Leafl, Harvard Univ. 28 (1980) 271-275].

No chemical studies have been carried out on the genus *Pagamea.*

CAMPANULACEAE

Lobelia tupa Linnaeus, Sp. Pl., Ed. 2 (1963) 1318.

This six-foot Lobelia, a beautifully majestic plant of the Andes of southern Peru and northern Chile, is widely recognized in Peru as a toxic plant. It is called *tupa* or *tobaco del diablo* ("devil's tabacco") (Mariani R: loc. cit., 363-364).

Much more remains to be known concerning the ethnobotany of this plant. Is it smoked, as the name *tabaco del diablo* might suggest? If not, how is it used; or is it merely avoided as a toxic species?

Tupa is rich in lobeline and derivatives, constituents which could be responsible for toxicity; but, if the plant is employed narcotically, what is the psychoactive principle [Hegnauer: loc. cit. 4 (1966) 409, 411]? These constituents could not be responsible for hallucinogenic properties.

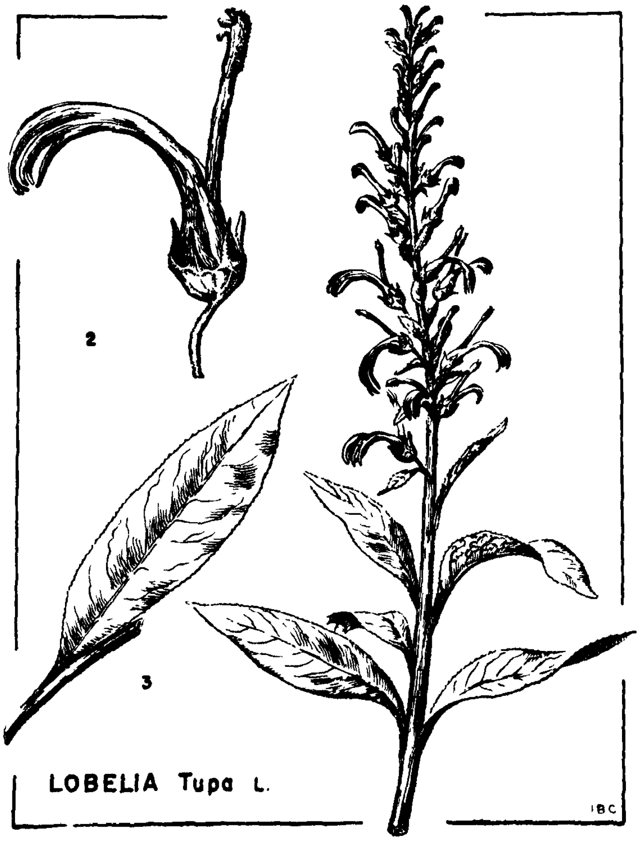

Fig. 4: *Lobelia tupa* L.

COMPOSITAE

Eupatorium solidaginifolium A. Gray, Pl. Wright. 1 (1852) 87.

This plant is smoked by the Papago Indian shamans of Arizona during séances. The native name of the species is *pihol* (Herbarium collection *F. J. Lipp sin. num.*).

Several alkaloids have been isolated from species of *Eupatorium*, but they do not appear to be psychoactive (Raffauf: loc. cit.).

Helichrysum foetidum Moench, Method (1794) 575.

H. stenopterum DeCandolle, Prodr. 6 (1838) 201.

Two species of *Helichrysum* are employed in Zululand by medicine men.

Although coumarins and diterpenes are reported from this genus, psychoactive principles appear to be absent [Hegnauer : loc. cit., 3 (1964) 478 ff.].

Tagetes lucida Cavanilles, Icones 3 (1795) 33, t. 264.

Among the Huichol Indians of Mexico, a mixture of *Tagetes lucida* and *Nicotiana rustica* is smoked to induce visual hallucinations. This marigold (*T lucida*) is often smoked alone for these effects (Diaz: loc. cit. 162-163).

Alkaloids are not known from this genus, but it does contain heavy concentrations of essential oils and thiophene derivatives.

Trichocline reptans (Wedd.) Hieronymus in Engler, Bot. Jahrb. 21 (1896) 369.

In the folk medicine of northern Argentina, the woody rhizome of this plant is smoked and is believed to be an effective cure for "stomach ache". Several species are called *contra-yebra*, a term indicating a panacea-type medicinal value.

In former times, the root of *coro* was employed "as a narcotic" by the Calchaqui Indians in the form of an additive to their alcoholic chicha (fermented beer made with maize) ; it was considered a strong inebriant. Later references indicate that several tribes of Indians of the Chaco smoked the powdered root along or with tobacco [Zardini : Bot. Mus. Leafl., Harvard Univ. 25 (1977) 105-107].

Several other species of *Trichocline* are similarly employed and are known in Argentina by the same vernacular name: *T exscapa* Griseb. and *T dealbata* Benth. et Hooker fil.

Whether or not the narcotic properties of coro are hallucinatory has not been established. Nothing apparently is as yet known of the chemical composition of members of this genus.

REFERENCE

Jeffrey, C. E. Survey of Hallucinogens. *Bot. Mus. Leafl.* Harvard Univ. 28: 186-190. 1980.